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STIMULUS CONTROL IN THE EXPERIMENTAL STUDY OF COOPERATION[1]

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The cooperative responses of pairs of human subjects were reinforced under several stimulus conditions in two settings designed to require a "social" response, *i.e.*, where at least one of the two persons is responding to the behavior of the other. The first task, designed by Lindsley and Cohen, required individual responses within 0.5 sec of one another for reinforcement. The second (modified) task required a delay of 3 sec between individual responses. To determine dependence of cooperation on social stimuli, rates of cooperative behavior on these tasks were compared in the presence and absence of a stimulus indicating to each subject the other's response and a stimulus which indicated the duration of the timeout after reinforcement. The results indicated that only in the modified task was a high rate of cooperation always contingent upon the presence of the social stimuli.

Research by Lindsley (1966) and Cohen (1962) has led to the development of a particularly promising experimental situation for the study of social interaction. Based in part on earlier settings designed by Skinner (1953) and Azrin and Lindsley (1956), Lindsley and Cohen's apparatus provides a free operant method for measuring "cooperation", "competition", and "leadership".

The Lindsley setting included controlled contingencies for two subjects. Each subject was seated in a separate room in front of a panel containing a plunger (Lindsley knob), stimulus lights, and a device to dispense reinforcers. Electronic programming apparatus defined pairs of responses by the two subjects. A cooperative response, defined when subjects pulled their plungers within 0.5 sec of one another, was reinforced with a mixture of money and candy. An individual response, defined when either of the subjects pulled his plunger twice in a row without either of the pulls being part of a team response, was followed by a 2.5-sec timeout accompanied by darkness and a loud tone. Each cooperative response was followed by a 5-sec period (timeout) during which the room lights dimmed and a light appeared in the reinforcement bin. During this period no responses were recorded. With the 5-sec timeout following reinforcement, the maximum number of reinforced responses was approximately 11 per min. The two subjects' rooms were separated by a sliding partition which could be opened to permit teammates to observe one another. When the partition was closed, a subject's pull was indicated to his teammate by the illumination of a light on the latter's panel (response light).

With the use of either mechanical or human stimuli, the coordinated response was designed to require that one subject respond to the behavior of the other. Lindsley suggests that the 0.5 sec within which the subject's responses must be coordinated is sufficiently short to avoid coordination merely by chance (Lindsley, 1966). The present research indicates, however, that subjects in this setting *can* achieve cooperative responses without attention to their partner. For example, with a 0.5-sec requirement for responses by the two subjects, individual rates in excess of 120 per min by both subjects will necessarily bring some response pairs within bounds. Similarly, if both subjects respond immediately after a timeout, a cooperative response results. If these occur frequently, the behavior of the subjects may not be interpreted with confidence as being

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"social", *i.e.*, that at least one of the two individuals is responding to the behavior of the other (Keller and Schoenfeld, 1950; Skinner, 1953; Azrin and Lindsley, 1956).

One means of minimizing these response correlations is to alter the requirements for reinforcement by adding a delay between the two responses. Accidental response correlations in the present research were minimized by imposing a criterion of more than 3 sec but less than 3.5 sec between the leader and follower responses. The response made by the first subject illuminated a response light on the other's panel for the duration of the 3-sec interval; reinforcement occurred if the second subject pulled his plunger within 0.5 sec after the response light went out. No response was defined whenever the second subject pulled before the end of the 3-sec interval or more than 0.5 sec after the light went out. Consecutive pulls by the subject responding first reinitiated the response light for 3 sec. The effectiveness of this procedure was assessed by comparing the rates of cooperative response on the original task used by Lindsley and Cohen and the modified task under conditions defined by the presence or absence of the response light indicating the other subject's pull and a stimulus which indicated the duration of the timeout after reinforcement (timeout light).

METHOD

Subjects

Six pairs of subjects, composed of freshman and sophomore students who volunteered to be paid research subjects, were studied. In two pairs both subjects were male; in four pairs both were female.

Apparatus

The setting in which the two types of responses were compared differed somewhat from that used by Lindsley and Cohen. The reinforcer was money but the pennies were not dispensed directly to the subjects. Instead, the accumulated total earnings of the subject and his partner were indicated on separate labelled counters on each subject's panel. Lights placed next to these counters flashed for every reinforcement count registered. The length of a timeout after a cooperative response was indicated by a light on the panel (timeout light) which extinguished for its duration. An individual response under the original contingencies was followed by a 2.5-sec tone with the timeout light off for the subject making the response. To make the maximum response rate on the modified task comparable to that on the original task, the timeout following reinforcement was reduced from 5 to 2 sec. Thus, with the 3-sec interval between responses, a minimum of 5 sec had to elapse between reinforced responses. The lights, plungers, and counters were labelled as to their function. The response, reinforcement, and timeout lights were also distinguished from each other by color. As in one of Lindsley's conditions, a subject's pull was indicated by a response light. Subjects could not observe one another or hear any sounds or noise from the other's apparatus.

Procedures

Each pair of subjects worked four sessions of approximately 2-hr duration, two sessions on each task. Half of the pairs worked first on the original task; half on the modified task. Before work during the first session for either task, subjects received a brief description of the reinforcement contingencies over a communications system and made several reinforced responses. No stimulus changes were made during the first 2-hr session using a given task. During the second session, five stimulus conditions were studied. Each condition was maintained for 20 min. In Condition 1, both the timeout and response lights were operative as in the previous 2-hr session. In Condition 2 the timeout lights were operative, but the response lights inoperative. In Condition 3 the response lights were operative, but the timeout lights inoperative. In Condition 4 both the response lights and timeout lights were inoperative. Finally, in Condition 5 both the timeout and response lights were operative, as in Condition 1. For four of the six pairs the conditions were presented in the above order. For the other two pairs Conditions 2, 3, and 4 were presented in reverse order. Before Conditions 2, 3, and 4, subjects were told which lights would be inoperative.

RESULTS AND DISCUSSION

Figure 1 compares cooperative response rates under the five stimulus conditions of the

second session on each task. The results indicate that with the original task, cooperative response rates were moderate to high under all conditions. When both timeout and response stimuli were present, subjects typically did not respond during the timeout and made few unreinforced responses. In the absence of response lights, subjects tended to pull simultaneously when the timeout lights went out. In the absence of the timeout lights, three of the pairs continued to respond during the timeout and thus made a number of unreinforced responses. With the absence of both response and timeout lights, substantial coordination was obtained either by responding rhythmically throughout the timeout or by responding individually at a high rate.

With the modified task, the rates were near zero in Conditions 2 and 4 in which the response lights were off, and moderate to high in the other conditions with the response lights present. As with the original task, subjects continued to respond during the conditions in which the response lights were absent. The cooperative response rates, however, were extremely low, less than 4% of the rates when the response lights were available. Thus, the achievement of high rates of cooperation in this setting seems to require that the behavior be "social".

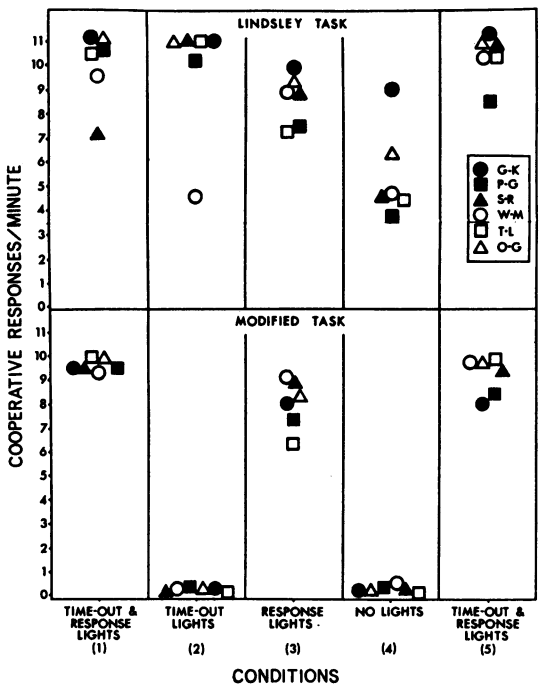

Fig. 1. Cooperative response rates under the stimulus conditions in the Lindsley and modified tasks. Pairs G-K, P-G, and S-R worked first on the Lindsley task: W-M, T-L, and O-G worked first on the modified task. For S-R and O-G, Conditions 2, 3, and 4 were presented in reverse order. P-G and T-L were males; all others were females.

The findings with the original task indicate that the presence of either the response or timeout stimuli can result in a high rate of cooperation. However, they do not indicate which stimulus tends to be used when both are present. Additional data were obtained to explore this point. Previous research with the apparatus indicated that a reaction time of at least 0.2 sec was required for a subject to respond if he were using the other's pull (response light) as a discriminative stimulus. Thus, if the subject pulling second is responding to the behavior of the other, few of his pulls should fall within 0.2 sec of his partner's. On the other hand, if both subjects are responding to the timeout stimulus, near simultaneous responses are likely to occur, and a substantial proportion of the "second" responses should fall within this interval. Similarly, with the modified task, where the data indicate that the response light is required for a cooperative response, few of the second responses should fall within a 0.2-sec interval following termination of the response light.

The results from the original task with both stimuli present indicated that response intervals of less than 0.2 sec occurred in more than 80% of the cooperative responses for three of the six pairs, and in less than 20% of the responses for the remaining three. Under the modified task with both stimuli present, response intervals of less than 0.2 sec occurred in no more than 2% of the cooperative responses for any pair.

Although the primary concern of this experiment was to define cooperation, the results may have important consequences regarding the interpretation of "leadership" as well. Lindsley has attributed leadership in his task to one member of the pair whenever he was the first to pull. However, when subjects are not monitoring each other's behavior but, instead, are pulling almost simultaneously after the timeout, the apparatus still defines one of the two responses as occurring first, no matter how small the difference in time. Under these conditions attributed leadership may, on occasion, only reflect more rapid motor responses.

With the modified task the possible ambiguities in the interpretation of leadership appear to be avoided. The greater temporal separation required of leader and follower responses ensures a distinct sequence which seems to be a definite advantage of the modifications.

REFERENCES

Azrin, N. H. and Lindsley, O. R. The reinforcement of cooperation between children. *Journal of Abnormal and Social Psychology*, 1956, **52**, 100-102.

Cohen, D. J. Justin and his peers: an experimental analysis of a child's social world. *Child Development*. 1962, **33**, 697-717.

Keller, F. S. and Schoenfeld, W. N. *Principles of Psychology*. New York: Appleton-Century-Crofts, 1950.

Lindsley, O. R. Experimental analysis of cooperation and competition. In Thom Verhave (Ed.), *The experimental analysis of behavior*. New York: Appleton-Century-Crofts, 1966. Pp. 470-501.

Skinner, B. F. *Science and human behavior*. New York: Macmillan, 1953.

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